Value of Consistent Condom Use: A Study of Sexually Transmitted Disease Prevention Among African American Adolescent Females

Richard A. Crosby, PhD, Ralph J. DiClemente, PhD, Gina M. Wingood, ScD, MPH, Delia Lang, PhD, and Kathy F. Harrington, MPH, MAEd

A recent report suggested that evidence was insufficient to evaluate the degree of benefit provided by condoms against most sexually transmitted diseases (STDs).[1] However, in vitro evidence[2–4] suggests that transmission of the largest STD pathogens (i.e., bacterial and protozoans) can be prevented by condom use. This study prospectively determined the association between African American adolescent females' condom use and their acquisition of biologically confirmed infection with *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, or *Trichomonas vaginalis*.

METHODS

Study Sample

From December 1996 through April 1999, sexually active African American adolescent females (aged 14–18) were recruited from multiple venues (medical clinics and high schools) in low-income neighborhoods of Birmingham, Ala. The study achieved an 85.7% baseline participation rate. Ninety percent returned for the 6-month follow-up assessment (n=468). Of these adolescents, 390 (83%) engaging in penile-vaginal sex between the 2 periods constituted the sample.

Data were collected at the University of Alabama Family Medicine Clinic and were gathered as part of a randomized controlled trial of an HIV prevention program.

Study Design

The design was modeled from a recent publication describing necessary conditions for testing hypotheses about condom effectiveness.[5] To establish an infection-free cohort at baseline, we tested adolescents with DNA amplification measures (for *C trachomatis*, *N gonorrhoeae*) and culture for *T vaginalis*. Those with positive test results were notified and treated. All treatments were verified.

Six months later, interviewers assessed adolescents' frequency of engaging in penile-vaginal intercourse since baseline and the number of times condoms were used during these sexual encounters. The latter measure was divided by the former to create a distribution representing proportional condom use. This distribution was dichotomized to compare consistent (100%) users with remaining adolescents with respect to STD incidence as measured by repeated testing.

Laboratory Measures

At both assessment periods, adolescents provided 2 (self-collected) vaginal swabs. One was placed in a transport tube (Abbott LCx Probe System; Abbott Laboratories, Abbott Park, Ill) and tested for *C trachomatis* and *N gonorrhoeae* DNA by ligase chain reaction.[6,7] Studies have confirmed the high sensitivity and specificity of these procedures.[6–9] The other swab was used to inoculate culture medium for *T vaginalis* (InPouch TV test; BioMed Diagnostics, San Jose, Calif).[10]

RESULTS

At baseline, 28.2% had positive test results for at least 1 STD. Six months later, adolescents provided information about their sexual behaviors after the baseline assessment. The mean frequency of penile-vaginal sex was 13.5 episodes (SD=24.2) and did not vary between those subsequently acquiring and not acquiring an STD (t=.40; P=.69). Fifty-one percent of the adolescents reported 100% condom use between the 2 assessment periods. The mean proportion of condom use among those not using condoms 100% of the time was 42%. At follow-up, valid specimens were obtained for 380 adolescents; 90 (23.7%) tested positive for at least 1 STD (chlamydia=16%; gonorrhea=3%; trichomoniasis=9%).

Among adolescents reporting 100% condom use, 17.8% had positive test results. By comparison, 30.0% of those reporting less than consistent condom use had positive test results. This difference was significant (relative risk ratio=1.69; 95% confidence interval=1.16, 2.46; P=.005) and remained significant after adjusting for whether adolescents had positive test results at baseline and the effects of having more than 1 sexual partner during the recall period (adjusted odds ratio=1.85; 95% confidence interval=1.13, 3.04; P=.01).

DISCUSSION

This study used a design specifically suggested for investigating condom effectiveness,[5] and the findings suggested that using condoms consistently could result in substantial, but not complete, protection against STD acquisition. Adolescents not consistently using condoms were about twice as likely to acquire an STD.

The study compared consistent (100%) users with all others. Precedent for this was established in seminal studies showing the protective value of condoms against HIV infection.[11,12] Thus, as suggested also by the Centers for Disease Control and Prevention,[13] our findings support the public health practice of promoting *consistent* condom use as a primary strategy to reduce STD incidence (efficacy of community- and clinic-based programs to achieve this goal has been well documented[14]).

Although the findings are encouraging, 17.8% of the adolescents acquired an STD despite 100% condom use. At least 3 forms of bias could have inflated the percentage with positive test results despite 100% use, thereby underestimating the protective effects. For example, evidence suggests that young people make multiple errors when using condoms.[15–17] Thus, one likely reason STDs occurred among 100% users is that condoms were used incorrectly. Furthermore, if condoms were not used from start to finish of intercourse (possibly a common phenomenon[18]), then the observed protective effect, again, was underestimated. Finally, if adolescents felt a social desirability bias when responding to interview questions about condom use, this also would inflate the number misclassified as 100% users. This misclassification would underestimate protective effects.

Other causes of study bias would result in random error (random error attenuates effect but does not bias in one direction). One example is possible treatment failure. To compensate, and to control for the potential effect of STD history on subsequent infections (as suggested in a recent study[19]), findings included an odds ratio adjusted for STD diagnosis at baseline. Another potential cause of random error may be recall bias relative to frequency of sex and condom use. Finally, it should be noted that findings are limited by convenience sampling and a sample size that precluded separate analyses of the 3 STDs. Further research is needed with larger samples that adequately represent diverse populations. ■

About the Authors

Richard A. Crosby, Ralph J. DiClemente, Gina M. Wingood, and Delia Lang are with Emory University, Atlanta, Ga. Kathy F. Harrington is with University of Alabama, Birmingham.

Requests for reprints should be sent to Richard A. Crosby, PhD, Emory University, Rollins School of Public Health, 1518 Clifton Rd, NE, Room 520, Atlanta, GA 30322 (e-mail: rcrosby@sph.emory.edu).

This brief was accepted December 9, 2002.

Contributors

R.A. Crosby, R.J. DiClemente, and G.M. Wingood conceived the analytic plan. R.J. DiClemente and G.M. Wingood obtained funding for the study and provided oversight throughout the study period. D. Lang, R.A. Crosby, R.J. DiClemente, and G.M. Wingood participated in data management and analysis. K.F. Harrington provided immediate supervision of the project, including all phases of behavioral data and specimen collection. All authors participated in the drafting and revision of the brief.

Acknowledgments

This study was supported by a grant from the Center for Mental Health Research on AIDS, National Institute of Mental Health (1R01 MH54412), to Ralph J. DiClemente.

Human Participant Protection

The University of Alabama institutional review board approved all study protocols.

References

1. US Dept of Health and Human Services. Workshop summary: scientific evidence on condom effectiveness for sexually transmitted disease (STD) prevention. Available at: http://www.niaid.nih.gov/dmid/stds/condomreport.pdf. Accessed July 5, 2001.

2. Carey RF, Lytle CD, Cyr WH. Implications of laboratory tests of condom integrity. *Sex Transm Dis.* 1999;26:216–220.

3. Lytle CD, Rouston LB, Seaborn GB, Dixon LG, Cyr WH. An in vitro evaluation of condoms as barriers to a small virus. *Sex Transm Dis.* 1997;24:161–164.

4. Lytle CD, Duff JE, Fleharty B, Bidinger RL, Cyr WH, Routson LB. A sensitive method for evaluating condoms as virus barriers. *J AOAC Int.* 1997;80: 319–324.

5. Crosby RA, DiClemente RJ, Holtgrave DR, Wingood GM. Design, measurement, and analytic considerations for testing hypotheses relative to condom effectiveness against non-viral STIs. *Sex Transm Infect.* 2002;78:228–231.

6. Hook EW III, Ching SF, Stephens J, Hardy KF, Smith KR, Lee HH. Diagnosis of *Neisseria gonorrhoeae* infection in women by using the ligase chain reaction on patient-obtained vaginal swabs. *J Clin Microbiol.* 1997;35:2129–2132.

7. Hook EW III, Smith K, Mullen C, et al. Diagnosis of genitourinary *Chlamydia trachomatis* infections in women by using the ligase chain reaction on patient-obtained vaginal swabs. *J Clin Microbiol.* 1997;35: 2133–2135.

8. Smith K, Harrington K, Wingood G, Oh MK, Hook EW 3rd, DiClemente RJ. Self-obtained vaginal swabs for diagnosis of treatable sexually transmitted diseases in adolescent girls. *Arch Pediatr Adolesc Med.* 2001;155:676–679.

9. Polaneczky M, Quigley C, Pollock L, Witkin SS. Use of self-collected vaginal specimens for detection of *Chlamydia trachomatis* infection. *Obstet Gynecol.* 1998; 91:375–378.

10. Schwebke JR, Morgan SC, Pinson GB. Validity of self-obtained vaginal specimens for diagnosis of trichomoniasis. *J Clin Microbiol.* 1997;35:1618–1619.

11. De Vincenzi I. A longitudinal study of human immunodeficiency virus transmission by heterosexual partners. *N Engl J Med.* 1994;331:341–346.

12. Saracco A, Musicco M, Nicolosi A, et al. Man-to-woman sexual transmission of HIV: longitudinal study of 343 steady partners of infected men. *J Acquir Immune Defic Syndr.* 1993;6:497–502.

13. Centers for Disease Control and Prevention. *Facts About Condoms and Their Use in Preventing HIV Infections and Other STDs.* Atlanta, Ga: US Dept of Health and Human Services; 1996.

14. Centers for Disease Control and Prevention. *Compendium of HIV Prevention Interventions With Evidence of Effectiveness.* Atlanta, Ga: US Dept of Health and Human Services; 1999.

15. Crosby RA, Sanders SA, Yarber WL, Graham CA, Dodge B. Condom use errors and problems among college men. *Sex Transm Dis.* 2002;29:552–557.

16. Crosby RA, DiClemente RJ, Wingood GM, et al. Correct condom application among African American adolescent females: the relationship to perceived self-efficacy and the association to confirmed STDs. *J Adolesc Health.* 2001;29:194–199.

17. Crosby RA, Yarber WL. Perceived versus actual knowledge about correct condom use among U.S. adolescents: results from a national study. *J Adolesc Health.* 2001;28:415–420.

18. Crosby RA, Sanders SA, Yarber WL, Graham CA. Condom use errors and problems: a neglected aspect of studies assessing condom effectiveness. *Am J Prev Med.* 2003;24:367–370.

19. DiClemente RJ, Wingood GM, Sionean C, et al. Association of adolescents' history of sexually transmitted disease (STD) and their current high-risk behavior and STD status: a case for intensifying clinic-based prevention efforts. *Sex Transm Dis.* 2002;29:503–509.